

# Sea Level Rise and Water Management in South Florida

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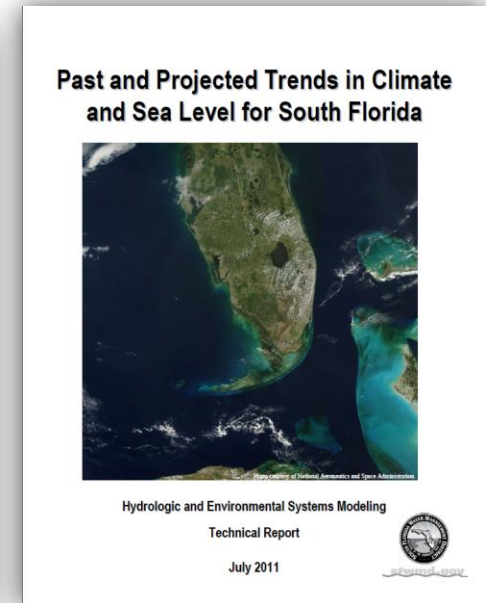
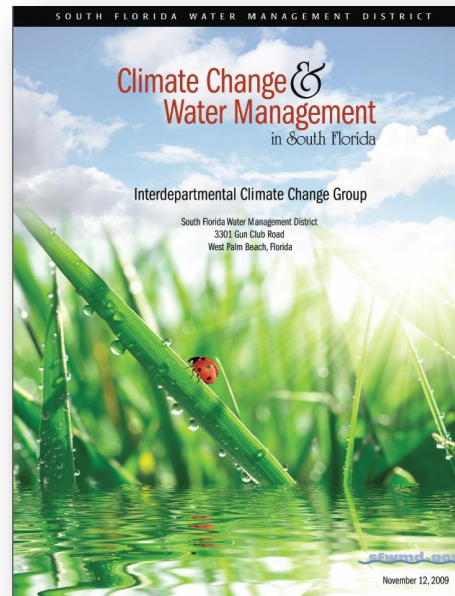
Chief Modeler

Hydrologic & Environmental Systems Modeling

Big Cypress Basin Governing Board Meeting  
February 21, 2013

# Initial efforts at SFWMD

- Briefings to GB & WRAC since May 2008
- Monitoring of science (climate variability & sea level rise)
- Produced two reports:



# Potential Climate Change Impacts to SFWMD

## Climate Change Drivers

### Natural Cycles

Interannual  
(e.g. El Nino and La Nina) to  
Multi-decadal  
(e.g. AMO\*), and  
Glacial

### Human Induced

Land use changes  
Greenhouse gases

## Quartet of change: Stressors

- **Rising Seas**
- **Temperature**
- **Rainfall, floods, and droughts**
- **Tropical Storms & Hurricanes**

## Water Management Impacts

- Direct landscape impacts (e.g. storm surge)
- Water Supply (e.g. droughts, saltwater intrusion)
- Flood Control (e.g. urban flooding, hurricanes)
- Natural Systems (e.g. ecosystem impacts, both coastal and interior)

# Sources of Sea Level Rise

What causes the sea level to change?

## Terrestrial Water Input

Terrestrial water storage, extraction of groundwater, building of reservoirs, changes in runoff, and seepage into aquifers

Surface and deep ocean circulation changes, storm surges

## Land-based Ice (Glaciers, Ice Sheets in Greenland, Antarctica)

Exchange of the water stored on land by glaciers and ice sheets with ocean water

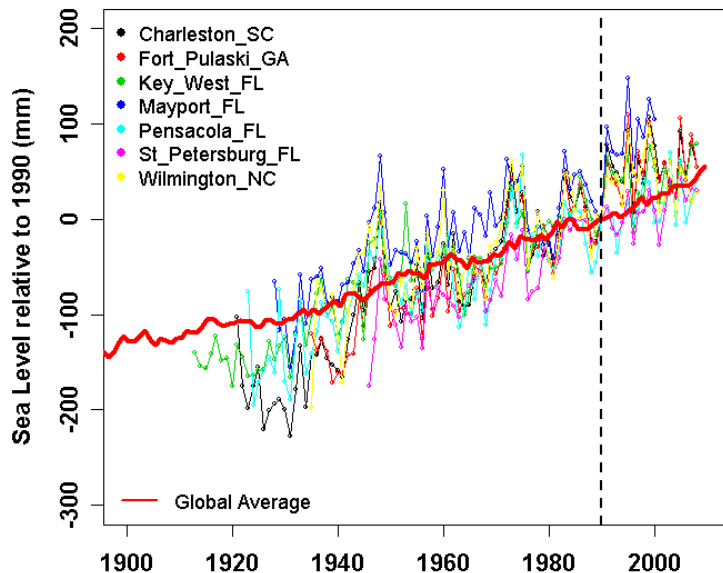
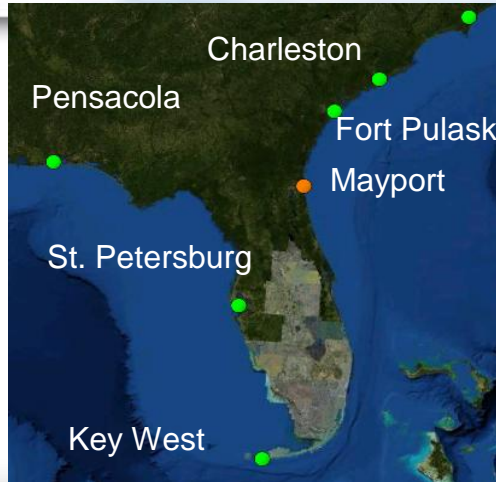
Subsidence in river delta region, land movements, and tectonic displacements

As the ocean warms, the water expands

## Thermal Expansion

## Vertical Land Movement

# Rising Seas – Tide Gage Data



- ❑ **Relative Sea Level**  
(height above a local datum) depends on:
  - ✓ **Global Mean Sea Level**
  - ✓ **Vertical Land Movement**  
(uplift/subsidence)
  - ✓ **Regional Variability**

# Recent Observations along SE Coast (“Sunny Day Flooding”)



Miami-Dade County  
Credit: Miami-Dade DERM

# More recent pictures..



A1A in Ft. Lauderdale



Broward County



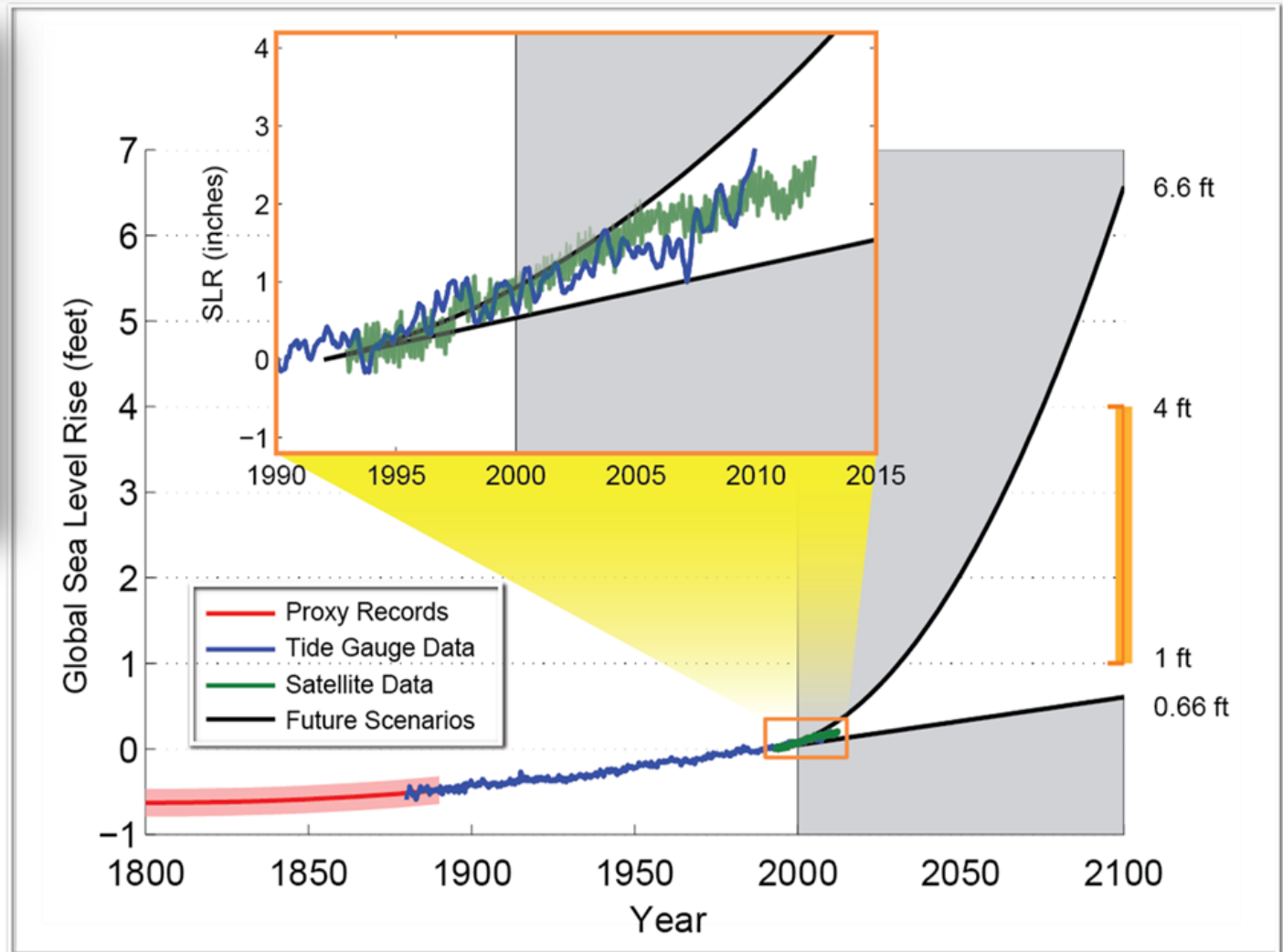
Miami Beach



# Projected range of sea level rise (National Climate Assessment, 2013)

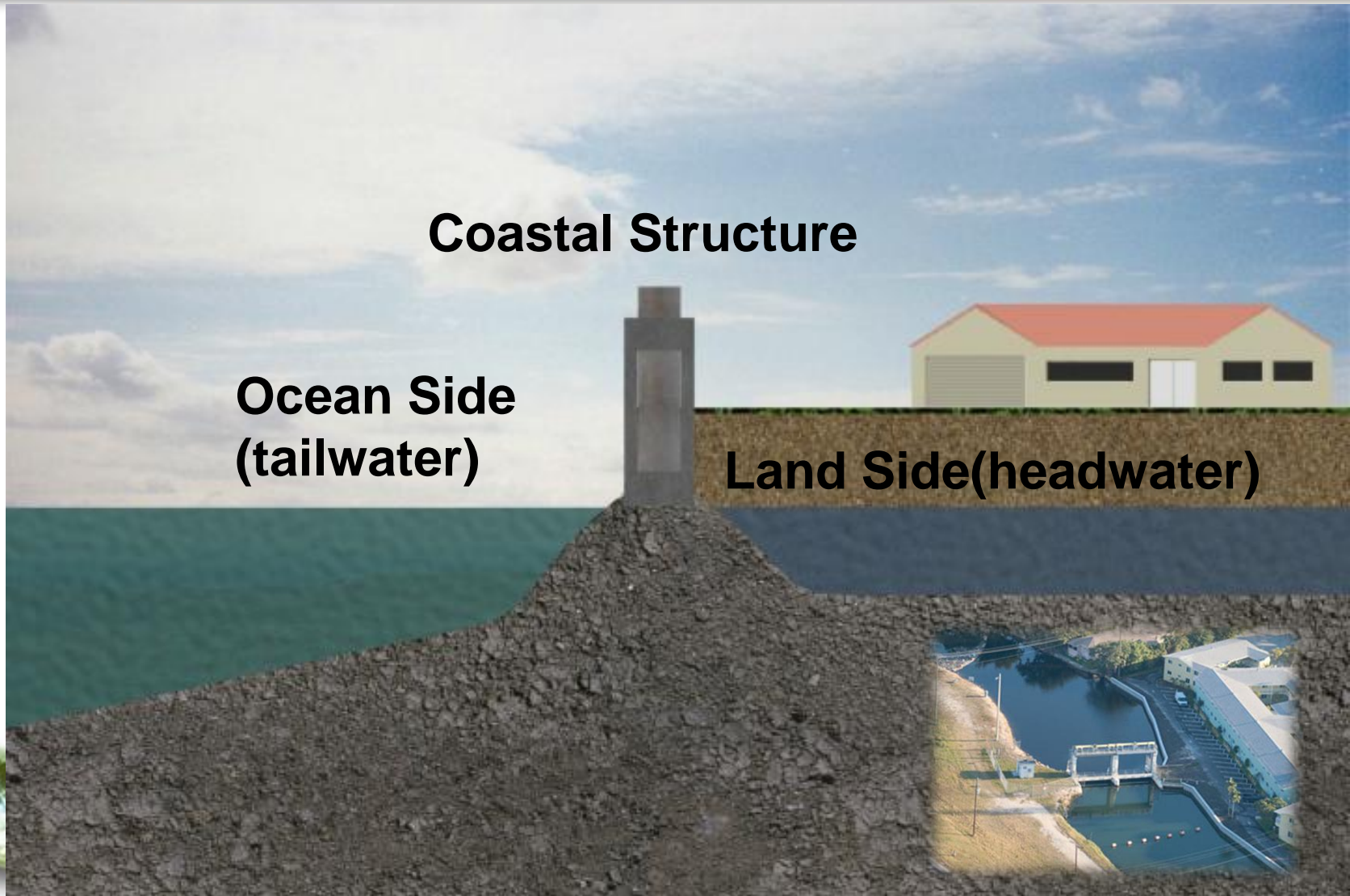
Global Sea Level Rise Scenarios for the  
United States National Climate Assessment

December 6, 2012



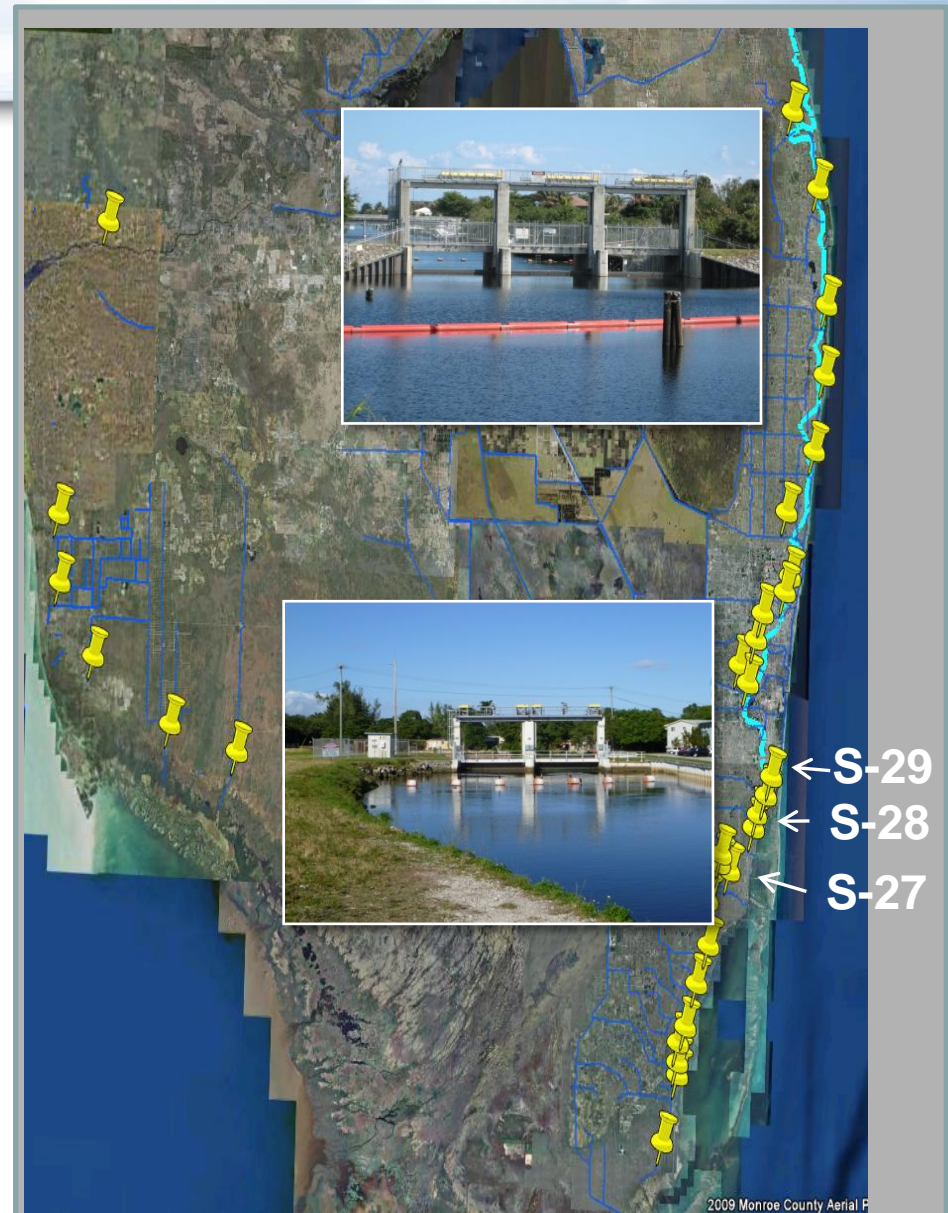
Draft report: <http://ncadac.globalchange.gov>

# Exposure: Flood Protection



# Review of Coastal Infrastructure

- Salinity Control Structures provide two primary functions: Barrier for saltwater intrusion and Flood Control
- C&SF system is approaching or exceeding design life expectancy. SFWMD routinely evaluates infrastructure on a 5 year cycle.
- 5 year and 10-year capital improvement budgets
- Complexity requires a thorough analysis: frequency and duration of flooding, impacts on downstream areas
- Coordination with local governments in dealing with local flooding

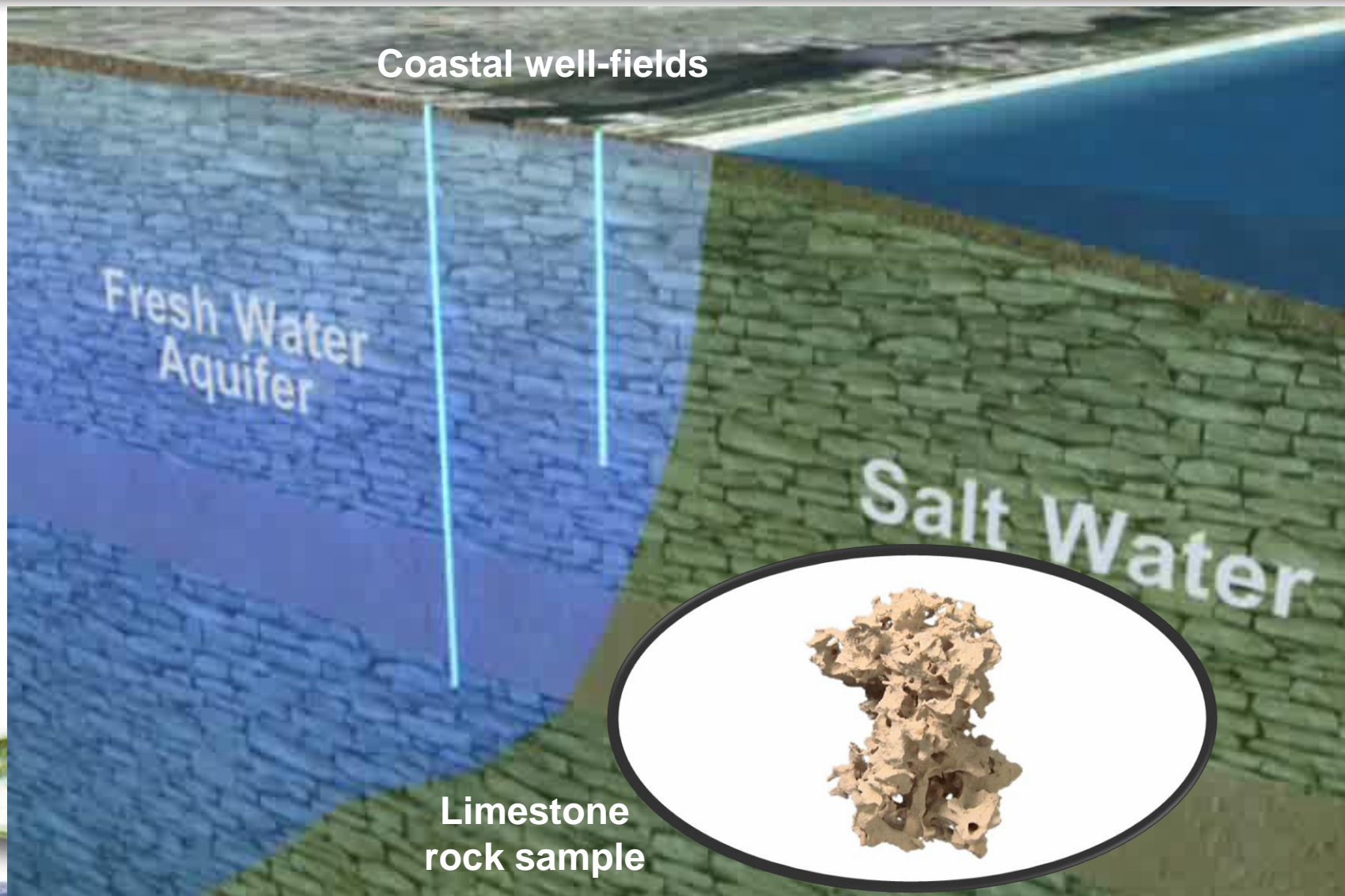


# Adaptation to Rising Seas where feasible

## Example: Forward Pumping at S-26 Structure

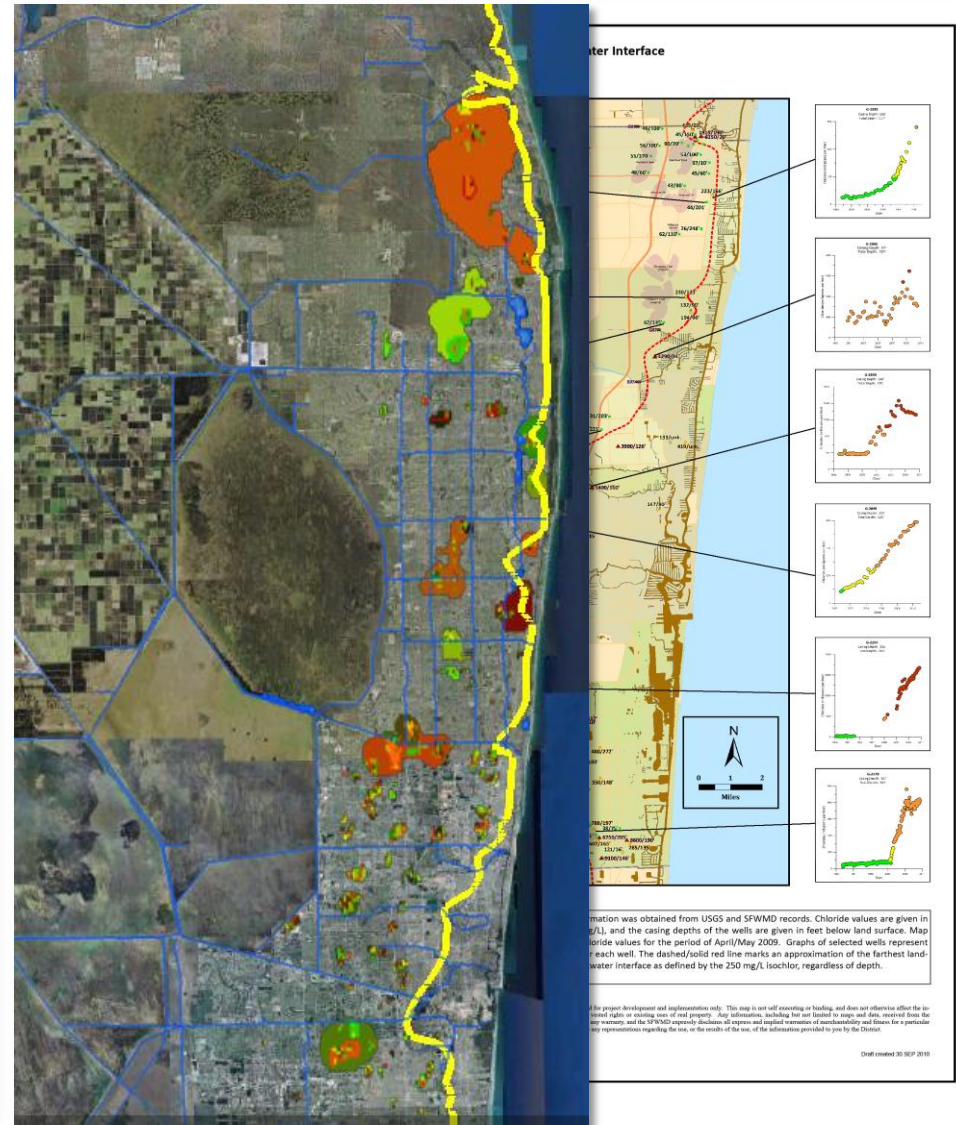
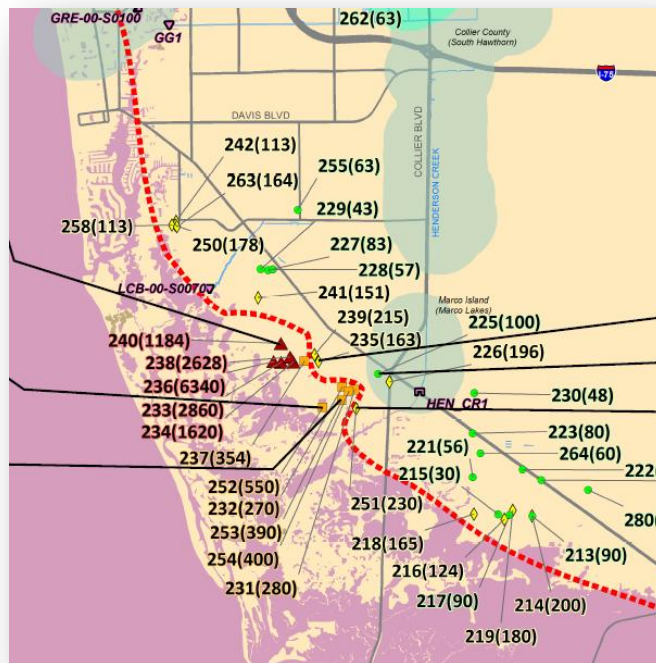


# Exposure: Saltwater Intrusion

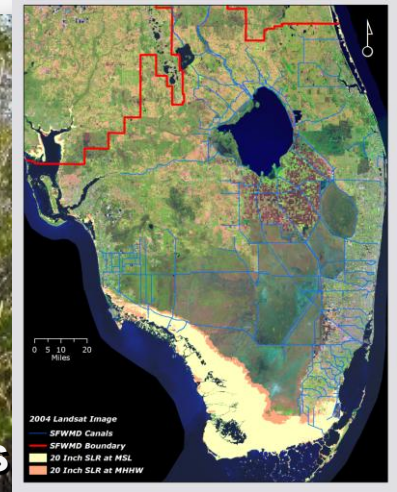


# Saltwater Intrusion Mapping (2009) and Monitoring Network Evaluation

- Developed draft saltwater intrusion maps for Broward, Palm Beach, Martin, and St. Lucie Counties, and the Lower West Coast aquifer



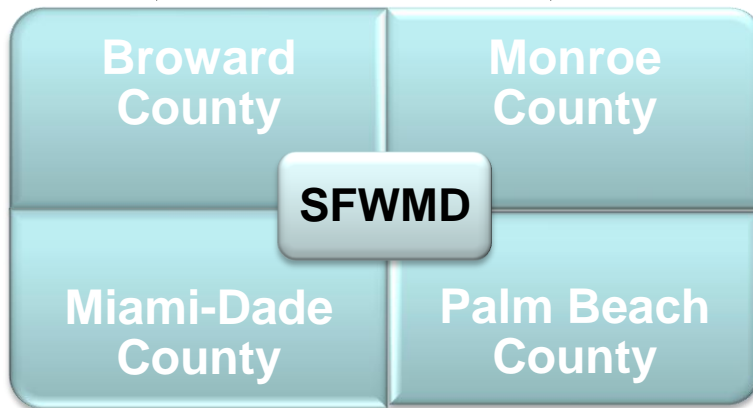
# Exposure: Inundation & Collapse of Freshwater Wetlands in the Southern Coasts



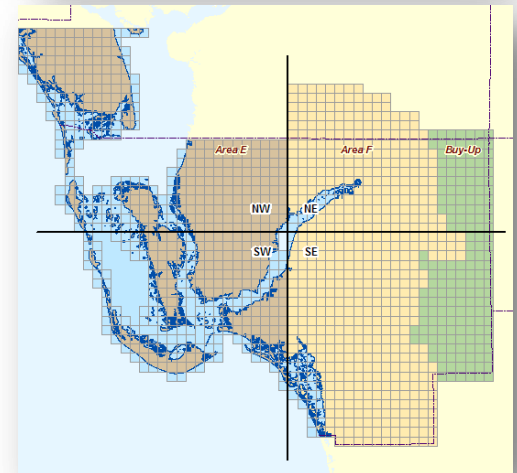
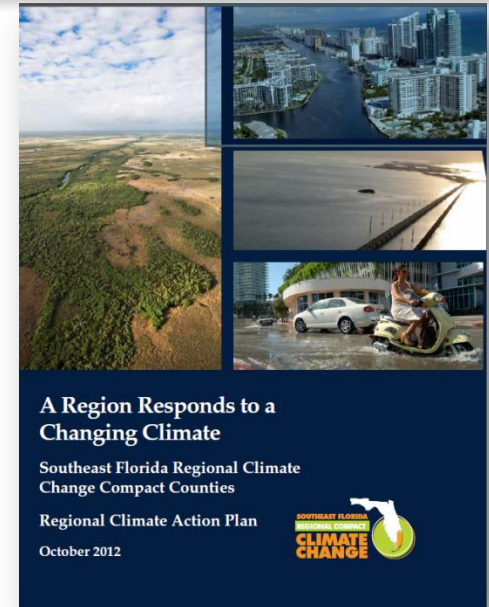
Credit:  
Prof. Hal  
Wanless

# Regional Coordination

- **Southeast Florida Regional Climate Change Compact (Palm Beach, Broward, Miami-Dade, and Monroe)**



- **SFWMD Participation**
  - Steering committee member (non-voting)
  - Technical assistance

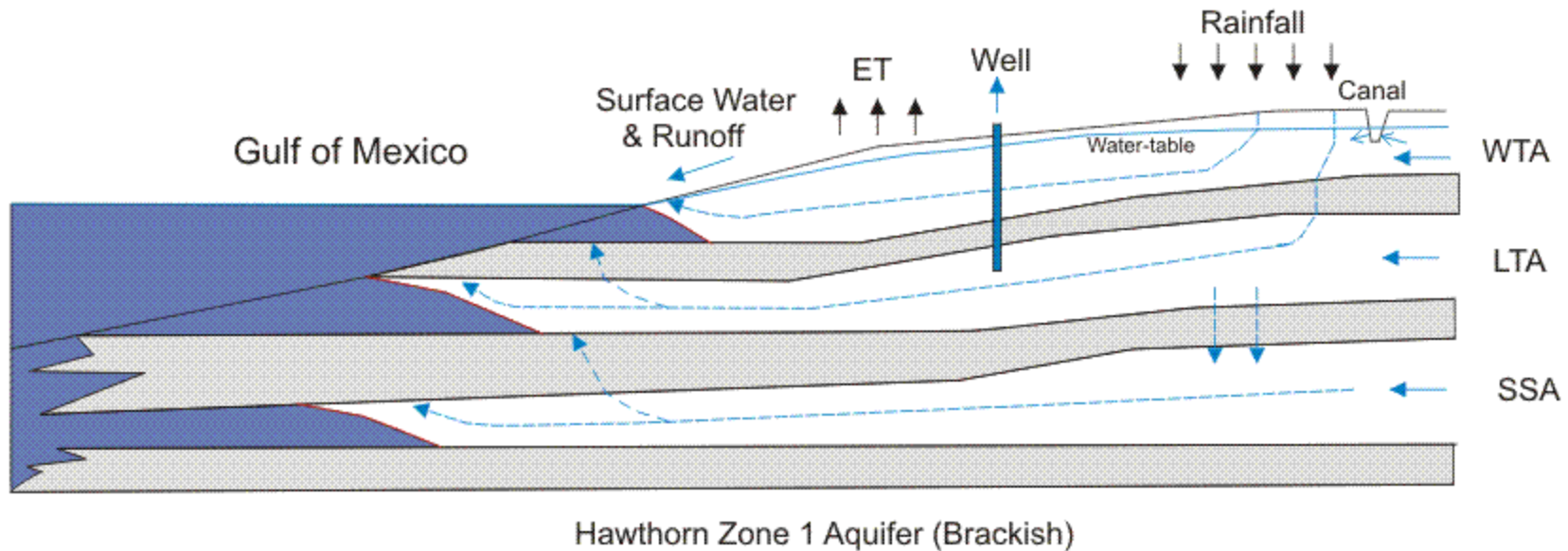


# Support for Big Cypress Basin Efforts

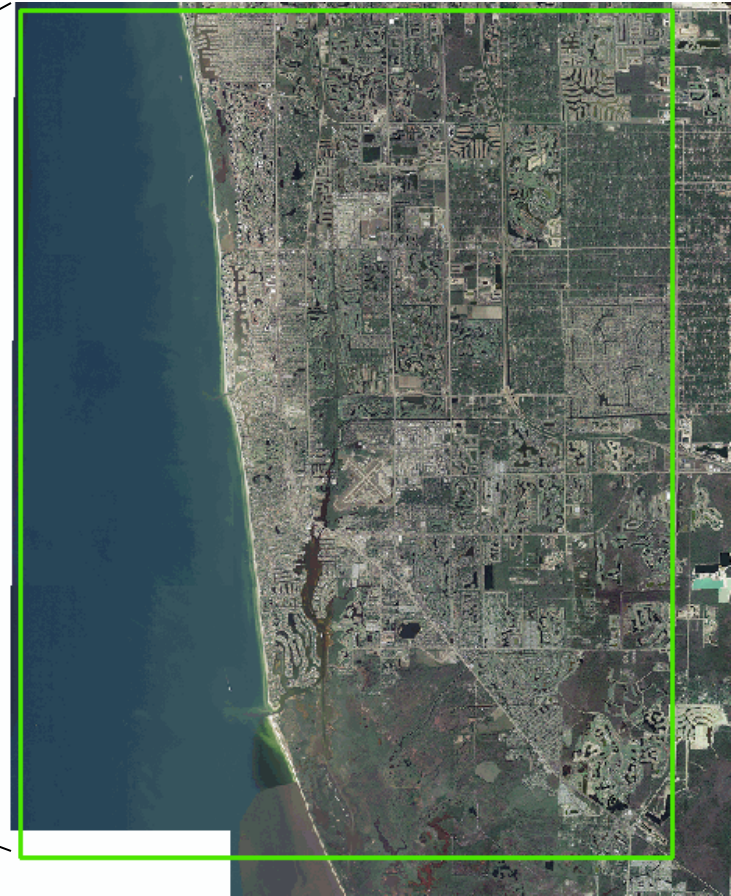
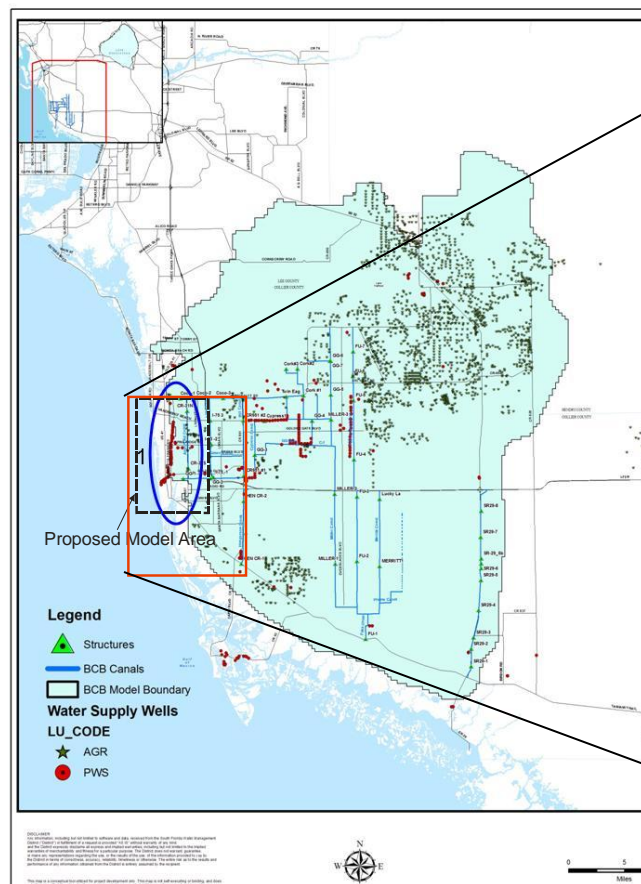
- Working closely with BCB engineers & modelers (Ananta Nath and Kent Feng)
- Initial Modeling of Saltwater Intrusion (Completed)
- Development of the baseline saltwater intrusion front for the Lower West Coast (Completed – to be updated every 5 years)
- Saltwater Encroachment Monitoring Network Improvement Plan (with assistance from US Geological Survey-report pending)



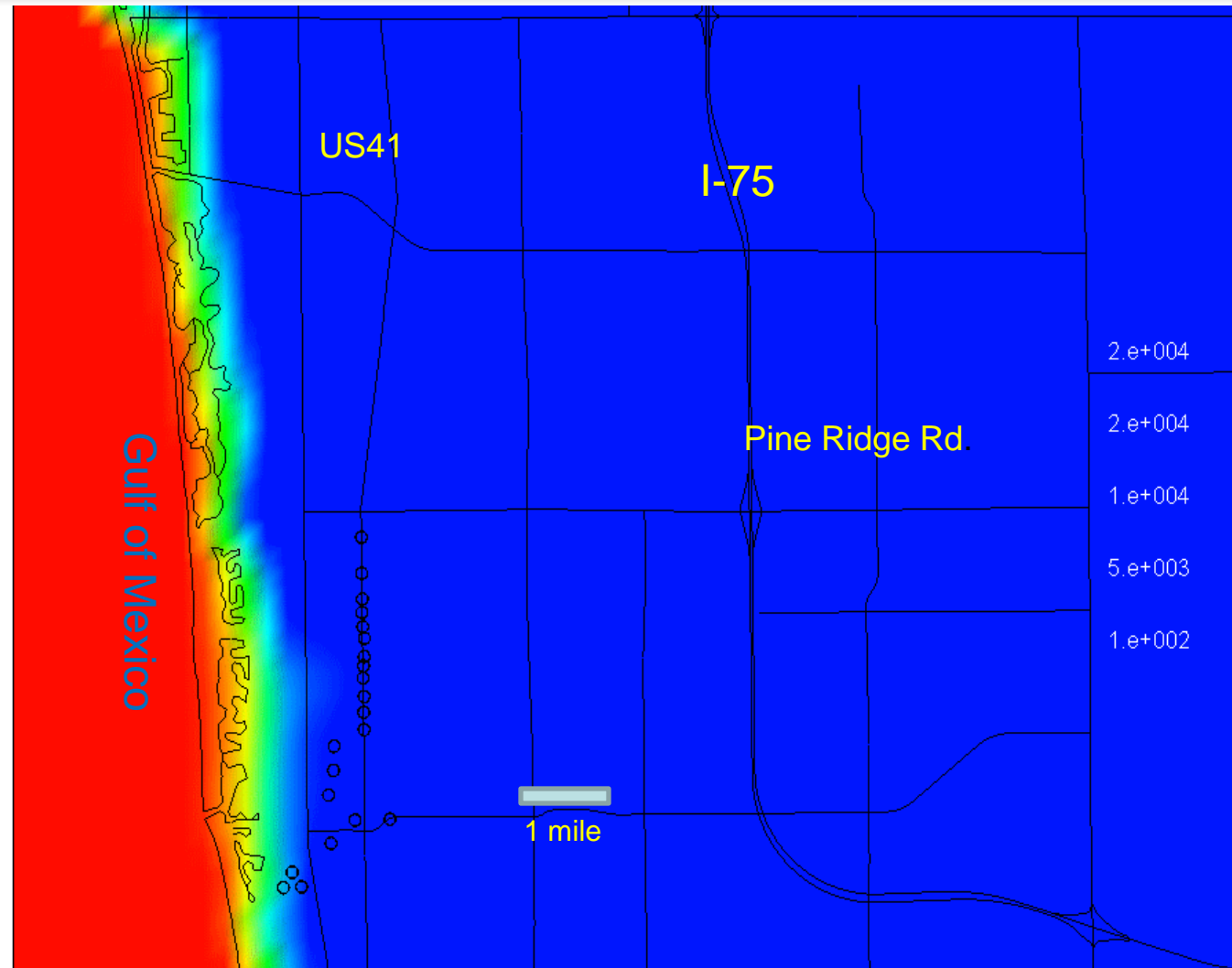
# West Coast Conceptual Model



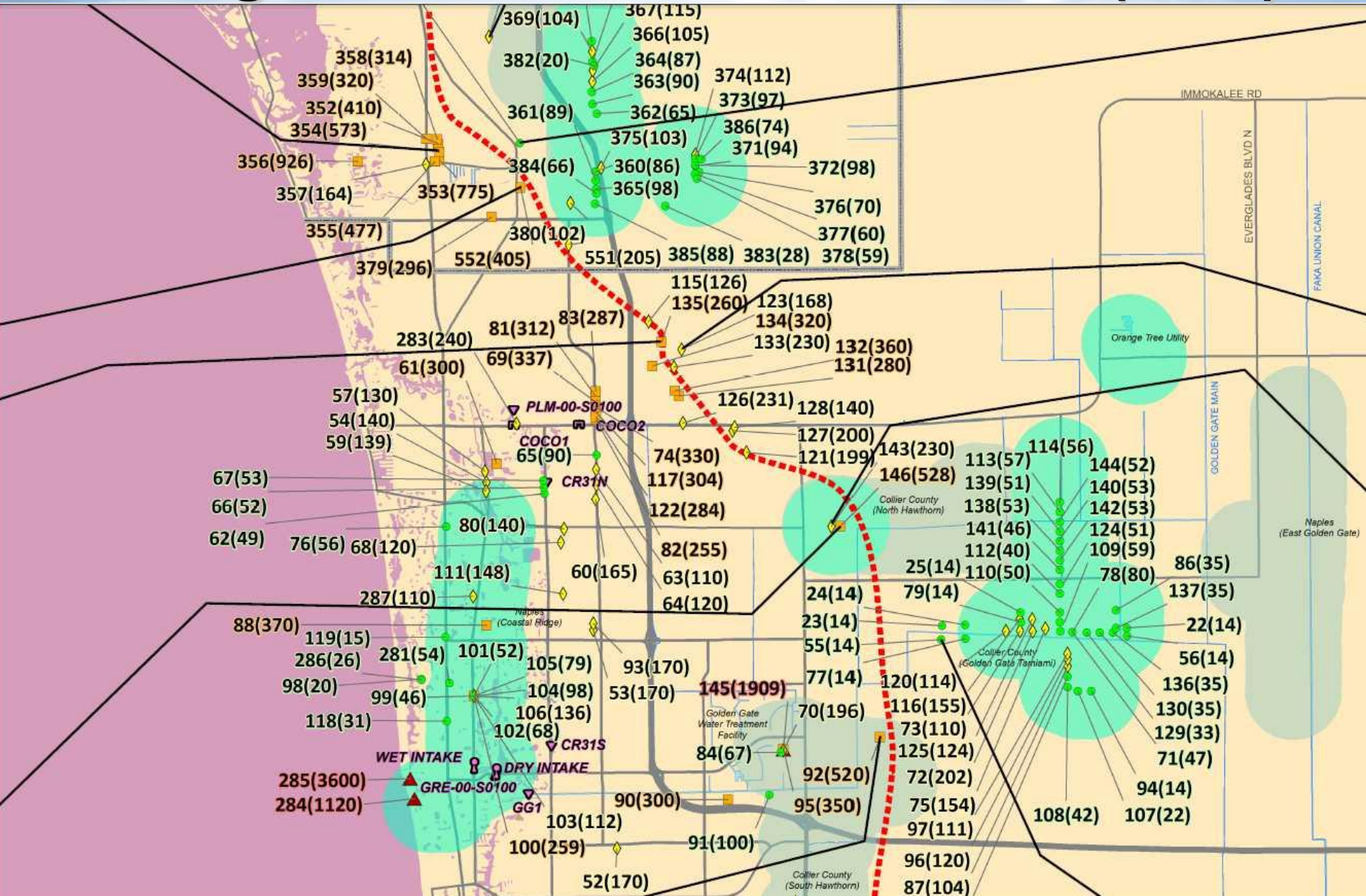
# BCB Salt Water Intrusion Modeling



# Movement of Saltwater



Time = 353.9 (2-1-36)



# Example Improvements to the Monitoring Network(USGS – report pending)

- Sampling techniques (computing purge volumes, using submersible pumps or kemmerers, understanding well construction)
- Technology (using TSEMI data sets, surface geophysics, etc.)
- New wells (short screened, PVC lined, logged prior to construction)
- Improved data access (web sites)
- Understanding sources of saline water (geochemistry)



# Questions?

